Chromosome records for five trigger plants (*Stylidium*; Stylidiaceae) from northern Australia

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Summary

Wege, J.A. (2004). Chromosome records for five trigger plants (*Stylidium*; Stylidiaceae) from northern Australia. Austrobaileya 6 (4): 957–959. Chromosome counts are reported for five species of *Stylidium* from northern Australia. In contrast to previous hypotheses, variation in number is evident: *S. lobuliflorum* and *S. ensatum* possess n = 11, *S. schizanthum* n = 14, whilst *S. semipartitum* and *S. turbinatum* possess n = 15. As for their south-western counterparts, cytogenetic factors are postulated to be involved in the speciation of trigger plants of northern Australia.

Keywords: *Stylidium*, trigger plants, chromosomes, speciation, breeding systems.

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Introduction

The majority of cytogenetic research performed on the trigger plant genus *Stylidium* has focussed on taxa endemic to the south-west of Western Australia. This region is a primary centre of species diversification for *Stylidium*, containing approximately 70% of the currently described taxa (Wagstaff & Wege 2002). Chromosome counts have been made for a high proportion of these taxa with numbers ranging from n = 5 to n = 16, with polyploidy occurring on 13, 14 and 15 (James 1979; Coates 1982; Burbidge & James 1991). Studies on morphologically allied species have shown that chromosome number change is often a feature of species differentiation (James 1979; Banyard & James 1979; Farrell & James 1979; Coates 1982). The hypothesized base number for the genus is n = 15 and several independent dysploid reduction series are thought to have evolved (James 1979).

Since James' (1979) landmark study, taxonomic research has seen a two-fold increase in the number of species of *Stylidium* known from northern Australia. With over 60 taxa currently described (see Bean 1999, 2000) this region must now be regarded as a second area of trigger plant diversity; however, there is only one published chromosome record. James (1979; pg 22) reported a count of n = 15 made by B. & G. Keighery, although the species in question was not identified and no voucher details were given. He considered all northern species to possess the basal number of n = 15. Chromosome numbers for additional species from northern Australian were sought in order to assess whether variation in chromosome number exists in this region.

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Methods

Buds were fixed in 3:1 absolute ethanol:glacial acetic acid for 24 hours, rinsed in 70% ethanol and subsequently stained with alcoholic hydrochloric acid carmine (Snow 1963). At least three separate counts were obtained from pollen mother cell meiotic material using the squash technique. Photographs were taken using a Zeiss Axiophot microscope and images captured using 6ASA imagelink film. Herbarium voucher specimens are lodged at PERTH.

Results

Variation in chromosome number between northern Australian species of *Stylidium* is demonstrated for the first time in the present study (**Table 1**). A haploid chromosome number of 11 was recorded for both *S. ensatum* and *S. lobuliflorum* (**Fig. 1**). *Stylidium turbinatum* was found to have a haploid chromosome number of 15.

An unidentified herbarium voucher specimen from south of Darwin with an annotation "chromosome count of n = 15" was recently uncovered at The University of Western Australia. The collection and count, performed by Bronwyn Keighery, is likely to correspond

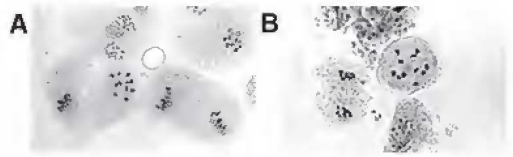

Fig. 1. Chromosomal preparations (n=11) for A) ***Stylidium ensatum*** and B) ***S. lobuliflorum***

to the n = 15 quoted by James (1979) as occurring in species from northern Australia. This specimen has since been identified as *S. semipartitum* and has been lodged at PERTH, with a duplicate sent to BRI.

A second voucher specimen with an unpublished chromosome count was found in the collection at PERTH. The count for *S. schizanthum* of n = 14 is likely to have been performed by Sid James (G. Keighery pers. comm.).

Discussion

Whilst the data presented here do not constitute a comprehensive survey, it is likely that chromosome change is associated with speciation of *Stylidium* across northern Australia. This notion raises a number of interesting questions. Do the tropical species exhibit similar variation in chromosome number as their south-west congeners? Is chromosome number differentiation a feature of morphologically allied species? What is the nature of the breeding systems in tropical trigger plants?

The last question is raised in view of the findings of Burbidge & James (1991) that dysploidy in *Stylidium* is typically associated with post-zygotic seed-aborting systems. Although the trigger plant flower appears designed to promote cross-pollination, high levels of inbreeding may be generated by geitonogamous self-pollination. The seed-aborting systems function to significantly reduce the amount of seed set after self-pollination as compared to cross-pollination. They have been shown to occur in many trigger plants from both south-western and south-eastern Australia (Banyard & James 1979; Coates & James 1979; James 1979; Burbidge & James 1991; Willis & Ash 1990). Burbidge & James (1991) also demonstrated that seed-aborting systems operate to varying degrees in *Stylidium* depending on the species in question. They can be absent, weak or highly efficient in species with the hypothesized base number of n = 15; however, those species with reduced chromosome numbers almost always exhibit efficient systems.

If one were to apply the results of Burbidge & James (1991) to the present study, one would expect efficient seed-aborting systems to be present in those tropical trigger plants with reduced chromosome numbers;

Table 1. Chromosome numbers (n) of species of *Stylidium* from Northern Australia

Classification (Milbraed 1908)	Species	Voucher	Approximate Locality	n
Subgenus *Andersonia* (R.Br) Mildbr.	*S. ensatum* A.R. Bean	JAW 470 (PERTH 05596513)	McMinns Lagoon, E of Darwin	11
	S. lobuliflorum F.Muell	JAW 478 (PERTH 05596521)	SW of Jabiru, Kakadu National Park	11
	S. schizanthum F.Muell	G.J. Keighery 4738 (PERTH 03163296)	Mitchell Plateau, Kimberleys	14
Subgenus *Tolypangium* (Endl.) Mildbr.				
section *Debiles* Mildbr.	*S. semipartitum* F.Muell	G.J. Keighery s.n. (PERTH 05596548)	Burrell's Creek S of Darwin	15
section *Floodia* Mildbr.	*S turbinatum* Lowrie & Kenneally	JAW 477 (PERTH 05596483)	Arhnem Highway, Kakadu National Park	15

however, this phenomenon would be an evolutionary disadvantage given the majority of these species are annuals and rely on seed set for regeneration. Burbidge & James (1991) found seed-aborting systems to be absent in the south-west annuals from *S.* section *Despectae* (n = 15). They noted that self-pollination is less likely to occur in these species because individuals are few-flowered and populations typically consist of very large numbers of plants over a small area. In contrast, geitonogamous self-pollination is a more likely occurrence in tropical trigger plants given the branched, many-flowered inflorescences and multiple scapes of many species. Further, Carlquist (1979) suggested that selfing is a favorable adaptation in tropical trigger plants and outlined a number of morphological features that may facilitate it, such as the widespread occurrence of a column pouch into which pollen can be shed, and from which the stigma can later receive. If such features have indeed evolved to promote self-pollination, then it is doubtful whether efficient seed-aborting systems have been associated with chromosome change in these species.

An alternative scenario is that tropical trigger plants with reduced chromosome numbers may possess weak seed-aborting systems, as is the case in *S. calcaratum* (n = 11) and *S. ecorne* (n = 13) from *S.* subgenus *Centridium* (for which there are northern Australian representatives) (Farrell & James 1979). Prior to this study, these two species were the only annual trigger plants recorded as having reduced chromosome numbers. Clearly further research is warranted on chromosome number variation in northern Australian trigger plants in conjunction with studies on the nature of their breeding systems.

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References

Banyard, B.J. & James, S.H. (1979). Biosystematic studies in the *Stylidium crassifolium* species complex (Stylidiaceae). *Australian Journal of Botany* 27:27–37.

Bean, A.R. (1999). A revision of *Stylidium* sect. *Debilia* Mildbr., *S.* sect. *Floodia* Mildbr. and *S.* sect. *Lanata* A.R. Bean (Stylidiaceae). *Austrobaileya* 5:427–455.

—— (2000). A revision of *Stylidium* subg. *Andersonia* (R.Br. ex G.Don.) Mildbr. (Stylidiaceae). *Austrobaileya* 5:589–649.

Burbidge, A.H. & James, S.H. (1991). Postzygotic seed abortion in the genetic system of *Stylidium* (Angiospermae: Stylidiaceae). *Journal of Heredity* 82:219–28.

Carlquist, S.J. (1979). *Stylidium* in Arnhem land: new species, modes of speciation on the sandstone plateau, and comments on floral mimicry. *Aliso* 9:411–461.

Coates, D.J. (1982). Chromosome variation and species relationships in the scale-leaved triggerplants (*Stylidium* Section *Squamosae*). *Australian Journal of Botany*. 30:121–130.

Farrell, P.G. & James, S.H. (1979). *Stylidium ecorne* (F.Muell. ex Erickson & Willis) comb. et stat. nov. (Stylidiaceae). *Australian Journal of Botany* 27:39–45.

James, S.H. (1979). Chromosome numbers and genetic systems in the triggerplants of Western Australia (*Stylidium*; Stylidiaceae). *Australian Journal of Botany* 27:17–25.

Mildbraed, J. (1908). Stylidiaceae. In Engler, A. (ed.) *Das Pflanzenreich*. IV: 278 (Wilhelm Engelmann: Leipzig.)

Snow, R.R. (1963). Alcoholic hydrochloric acid carmine as a stain for chromosomes in squash preparations. *Stain Technology* 38:9–13.

Wagstaff, S.J. & Wege, J. (2002). Patterns of Diversification in New Zealand Stylidiaceae. *American Journal of Botany* 89(5):865–874.

Willis, A.J. & Ash, J.E. (1990). The breeding systems of *Stylidium graminifolium* and *S. productum* (Stylidiaceae). *Australian Journal of Botany* 38:217–227.